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SPACE PERCEPTION.

Studies in Auditory and Visual Space Perception. By Arthur Henry Pierce, Ph.D. Pp. vi + 361. (New York, London and Bombay: Longmans, Green and Co., 1901.) Price 6*s.* 6*d.* net.

THE larger and more interesting part of this book deals with the problem of the localisation of sound. We all know that we, in common with other animals having the sense of hearing, can, with considerable accuracy, determine the direction from which a sound comes to us. We hear a lark, and after a little feeling about, if we may use such an expression, we are certain that the bird is not far from a place in the sky to which we can confidently point, and examining with our eyes the region near that point we soon see the lark.

In all ordinary efforts to find out where the source of sound is, we move our head, either alone or with our body. If the necessary movement is angularly small, we may move the head without moving the body, if it is large we must move the body; so far as the result is concerned it is indifferent how the head is moved, with or without the movement of the body.

What we do is to turn to the side from which the sound comes and continue this movement until the median plane of the head is in such a position that the slightest movement of the median plane will put the source of sound into the right or left hemisphere; we then know that the source of sound is in the median plane and in front. Having thus found a vertical plane containing the source of sound, we have next (and experience seems to show that this is really the order followed) to determine the place of the source of sound in the semicircle in front from zenith to nadir. This *could* be done in a precisely similar way. We might turn our head so that its vertical axis became horizontal and our median plane coincided with the horizontal plane, and now rotating the head about its vertical axis (now horizontal) we could get the source of sound into the median plane of the head. The intersection of the two planes each of which contains the source of sound would, of course, be the line passing through the head and the source of sound. Put more generally, by inclining the head we could find two positions of the median plane of the head each containing the source of sound, and the intersection of these planes is the direction sought. Birds seem to use this method, and it is worthy of note that birds have no concha, but human beings find what may be called the altitude of the source of sound in another way.

If we look at a source of sound, such as a splashing fall of water or a fizzing steam-pipe, the more complex the sound the better, and rotate the head about its right and left axis, so as to look now up, now down, now forward, we find that a very notable change of sound takes place just at the position of the head when we are looking straight at the source of sound. This rather abrupt change of quality of the sound seems to be caused by the acoustic shadow of the tragus. This shadow is, of course, not analogous to the black shadow to which we are accustomed when comparatively large bodies intercept a beam of light, but rather to the coloured shadow due to diffraction, and therefore does not diminish the intensity of the sound, but changes its quality. It may be noted that the tip of the tragus is almost exactly in front of the external meatus. Whether this explanation of the mechanism is correct or not, it seems certain that in locating sounds we do really turn the head (with or without the body) about a vertical axis until we find the source of sound in front, and then look up and down until we are looking at the source.

Now what has just been described is not at all what Prof. Pierce, and most of the authors whose experiments and speculations he discusses, mean by the localisation of sound. What they investigate is the question how far we can, *without moving the head*, determine the position of the source of a sound. All are agreed that we can tell with certainty whether the sound comes from the right or from the left or is in the median plane, but some think this is all, while some, including Prof. Pierce, think a good deal more than this can be made out without moving the head.

One defect in the account of many of these experiments is that no indication is given of how errors arising from involuntary and unconscious movements of the head are guarded against. In the experiments described it is found that the accuracy of localisation is greatest when the source of sound is nearly in front or nearly behind the observer. But these are exactly the positions in which a slight movement of the head gives the greatest help, so that unless care is taken to avoid any, however slight, movement of the head, we can gather little from the experiments as to the accuracy of localisation with the head fixed. There are three ways in which this source of error can be eliminated. First, by making the sound of such short duration that there is no time to turn the head during its continuance. This was the plan adopted by the present writer when he in 1874, at the meeting of the British Association in Belfast, recommended the snapping of two coins as the source of sound, and he is pleased to learn from Prof. Pierce that this form of the experiment is still used as a parlour amusement in America. Second, by mechanically fixing the head. It is difficult, though not impossible, to accomplish this without the introduction of apparatus which will interfere with the uninterrupted access of sound to the ears. Third, by recording any movement of the head which may take place by means of tapes placed round the head, the ends of the tapes being connected with a recording apparatus, so that the movement of the head may be noted. Experiments in which such movement occurred might then be excluded. It is well known that such involuntary and unconscious movements do occur. Most of us have heard of the device by means of which a famous French army surgeon used to detect feigned deafness in unwilling conscripts. He led the supposed deaf man along a stone-paved passage and secretly dropped a coin. The conscript jerked his head a little, on which the surgeon said, "My friend, you are not very deaf, you heard that franc fall." So unless we have some means of ensuring fixity of the head we cannot be certain that the greater accuracy of localisation in some positions is not, partly at least, due to involuntary and unconscious movement of the head.

The experiments on the spatial perception of two simultaneous sounds of similar quality are of special interest. Such sounds coalesce and give rise to a resultant or, as Prof. Pierce aptly calls it, phantom sound. As a rule this phantom sound is located at a position intermediate between those to which the observer would refer the two real components. These experiments with two coalescing sounds, not being liable to the same extent as those with one sound to the error introduced by unconscious movements of the head, may be of use to check such errors and to show that they exist. A very curious case, or set of cases, is examined by Prof. Pierce, who gives very fully the results of his own experiments and of those of other investigators. When the two component sounds, one on each side, are produced near the ears (4 cm. or less from each ear), the phantom is heard *within the cranium* and can be made to move inside the head towards the one or the other ear by varying the relative loudness of the components. When the distance of the two sounds from each of the ears is 8 cm. or more, the phantom is extra-cranial.

What seemed the most interesting points discussed in this essay have been noted; but the whole of it is interesting, and physicists and physiologists will find it well worth careful reading. The fairly complete bibliography annexed to it greatly adds to its value.

The second part of the book deals with some optical illusions, which are discussed with great critical acumen.

ALEX. CRUM BROWN.

THE MORPHOLOGICAL VALUE OF THE CENTROSOME.

Das Problem der Befruchtung. Von Dr. Th. Boveri. Pp. 48. (Jena: Gustav Fischer, 1902.) Price Mk. 1·80.

PROF. BOVERI is so well known as a cytologist that anything from his pen will be read with interest. He is concerned in the little work before us in presenting in a non-technical fashion the main morphological peculiarities connected with fertilisation, and he also discusses the meaning of the processes involved. The appendix will probably be regarded by many as the most interesting part of the whole, as he there critically examines the results which have been obtained by Loeb on artificial parthenogenesis, and which have been confirmed and further investigated by Wilson. It will be within the recollection of some people that Loeb discovered the important fact that it is possible to induce normal development in *unfertilised* eggs of certain marine animals by treating them for some time with a 12 per cent. solution of magnesium chloride in seawater, and then retransferring the eggs to normal seawater. Morgan and others had previously found that the addition of salts of various kinds to the water sufficed to produce bodies remarkably like centrospheres, but it was not until Wilson showed this also to occur in Loeb's experiments, and that they almost certainly initiate the process of segmentation, that the significance of the earlier results became apparent.

Now the egg is normally destitute of any centrosome, and it has been thought on many grounds that one of the chief uses of the sperm was to import this body into the protoplasm of the inert ovum. Boveri himself first put forward this view, and he now seems inclined to admit that it may demand some degree of modification. His original conception of the sperm as starting the cytoplasmic activities remains untouched, but obviously the nature of the mechanism involved is, as he says, open to a different interpretation from that originally assigned to it by himself. For it may now be fairly argued that it is not a centrosome as an *organised structure* which is introduced into the egg, and which there starts the segmentation processes, but rather a chemical substance which, in combination with the ovian cytoplasm, produces the body in question. Such a view would reconcile much that has hitherto been difficult of explanation in connection with the diverse behaviour of centrosomes in different organisms, and even in different cells and tissues of the same individual.

In cycads, for example, centrosome-like structures (blepharoplasts) are associated with the karyokinesis of the generative cell of the pollen tube, but they are absent from the rest of the antecedent cell-generations. Hence their morphological permanence can hardly be seriously maintained in such a case as this. Again, in many of the higher plants the spindle fibres which appear in the early prophases of karyokinesis (*e.g.* in pollen-mother cells of the lily) originate at many different spots in the cell, and this may probably be correlated with the extrusion of nucleolar substance which was described in this instance as long ago as 1893. Furthermore, such a conception of the possible nature of centrosomes enables one to harmonise the peculiar quadripolar spindles so characteristic of the lobed spore-mother cells of many liverworts.

It is clear, of course, that the acceptance of such a possible origin of centrosomes does not necessarily involve a denial of their possible permanence in other cases. But it does add another striking example to those cases in which a morphological character may be traced to physiological causes, the character itself only persisting for so long as the physiological stimulus continues to operate.

J. B. F.

ROSE CULTURE.

The Book of the Rose. By the Rev. A. Foster-Melliar. Second edition, with 33 illustrations. Pp. xiv + 352. (London: Macmillan and Co., Ltd., 1902.) Price 6*s*.

THE design of the author is "to show how roses may be grown in the best possible manner so as to produce the finest blooms"; and from his enthusiastic love and his long, successful culture of the flower, he has written such an exhaustive treatise that the reader who has the ambition, the energy and the means to follow his instructions cannot fail to achieve success. He gives clear and comprehensive details as to soil, situation, selection and treatment, where to erect a throne for the queen of flowers, and the homage which must be paid by those devoted subjects who would win her most gracious smiles. With a loyal service, which is never disheartened, the knight of the rose must be eager to maintain her supremacy against all comers. Without metaphor, he who would grow roses in their perfect beauty, and, like the author of this book, would be rewarded with medals and trophies, must obey the immutable law, must work for his wage, must train for the race if he would so run that he